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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/690,084	10/20/2003	Daniel A. Koos	NOVLP068/NVLS-000818	4873
22434	7590	02/14/2006	EXAMINER	
BEYER WEAVER & THOMAS LLP			VINH, LAN	
P.O. BOX 70250			ART UNIT	
OAKLAND, CA 94612-0250			PAPER NUMBER	
			1765	
DATE MAILED: 02/14/2006				

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/690,084

Applicant(s)

KOOS ET AL.

Examiner

Lan Vinh

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— The MAILING DATE of this communication appears on the cover sheet with the correspondence address —
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 December 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-76 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-32 and 34-76 is/are rejected.
- 7) ☒ Claim(s) 33 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>120805</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Arguments

1. Applicant's arguments, see page 10 of the response, filed 12/8/2005, with respect to claims 67-76 have been fully considered and are persuasive. A new office action is discussed below to properly address claims 1-76 (claims 43-76 are rejected based on a new ground of rejection under U.S.C 103(a) based on Ma et al (US 6,692,546) and Jun et al (US 2001/0038448)

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-9, 14-24, 28-32, 34, 36-42 are rejected under 35 U.S.C. 102(b) as being anticipated by Uzoh et al (US 6,355,153)

Uzoh discloses a method for fabricating a chip interconnect. The method comprises the steps of:

receiving the substrate containing a layer of metal 24 and a dielectric layer 2 (col 5, lines 45-47; fig. 3Bii)

polishing/etching metal from the substrate to a position below an upper level of the exposed dielectric layer (col 7, lines 54-56; fig. 3Biib)

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forming a capping layer 26 of Cu on at least exposed metal portions of the substrate by electroless deposition (col 8, lines 5-35)

The limitations of claims 2, 39, 42 has been described above

Regarding claims 3-4, 31-32, 40, Uzoh discloses that a capping layer comprises cobalt may be deposited on the exposed metal 24 (col 8, lines 53-55)

Regarding claims 5, 9, Uzoh discloses that the layer 24 is etched to a position below the level of the exposed dielectric 24 (fig. 3Biib)

Regarding claim 6, Uzoh discloses that wherein the capping layer is 0.1-10000 Angstroms thick (col 10, lines 46-48)

Regarding claim 7-8, 13, Uzoh discloses polishing/ etching metal from the substrate with a solution having an agent that passivates enhances the passivation of copper (col 9, lines 60-62), which reads on contacting the substrate with an etching solution that oxidizes the metal

Regarding claim 14, Uzoh discloses that the etching solution containing peroxide (col 9, lines 47-48)

Regarding claims 15-17, 21-23, Uzoh discloses that the etching solution containing benzotriazole/corrosion inhibitor, surfactant, an acid (col 9, lines 3-48; col 10, lines 10-11)

Regarding claim 18, Uzoh discloses that the solution removes most of the metal deposited on the substrate (col 10, lines 20-22)

Regarding claims 19-20, Uzoh discloses that the solution is acidic (col 9, lines 2-3)

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Regarding claim 24, Uzoh discloses using an acid bath (col 9, lines 23-24), which reads on dipping the substrate

Regarding claims 28-29, Uzoh discloses performing the step of planarizing /post etch of the substrate prior to forming the capping layer 26 (col 7, lines 53-55)

Regarding claim 30, Uzoh discloses forming layer 26/capping layer on the exposed metal layer by electroless deposition using an electroless solution (col 10, lines 65-67)

Regarding claim 34, Uzoh discloses the step of annealing the structure (col 11, lines 40-45)

Regarding claim 37, fig. 3Biia shows the metal layer 4 covering the upper level of dielectric layer 2

Regarding claim 41, Uzoh discloses depositing a layer of CoP on the metal layer (col 8, lines 54-55)

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 43-56 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma et al (US 6,692,546) in view of Jun et al (US 2001/0038448)

Ma discloses a method for using the slurry for polishing copper. The method comprises the step of:

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receiving the substrate containing a layer of metal 14 and a dielectric layer 12 (col 4, lines 55-66), the substrate comprises the layer 14 /overburden covering the dielectric field (fig. 1)

polishing/etching metal from the substrate to a position below an upper level of exposed dielectric by contacting the substrate with an etching solution comprising between about 0 to 3% of glycine by weight and between about 0.1% to 25 % of hydrogen peroxide by weight, at a pH in a range of between about 1-5 (col 8, lines 55-60; col 9, lines 15-37), contacting the metal with the slurry/etching solution (col 6, lines 44-46)

Unlike the instant claimed inventions as per claims 43, 48, Ma fails to disclose contacting comprises spraying the slurry/etching solution onto the wafer

Jun, in a method for detecting scratches on wafer, discloses that in CMP slurry is sprayed onto the wafer (col 1, paragraph 0004)

Since Ma discloses that the slurry/etching solution is dispensed directly onto the wafer (col 5, lines 58-59), one skilled in the art at the time the invention was made would have found it obvious to modify Ma step of dispensing slurry onto the wafer surface by spraying the slurry/etching solution as per Jun because it is conventional in the art of CMP to spray slurry/etching solution onto the wafer surface as taught by Jun

The limitations of claims 44, 49 has been described above

Regarding claims 45, 50, Ma discloses that the solution has a pH of 6.9 (col 8, lines 40-41)

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Regarding claims 46, 51, the claimed ranges is encompassed by Ma disclosed ranges as discussed above

Regarding claims 47, 52-53, Ma discloses forming copper/capping layer over the entire wafer which includes the exposed metal (col 10, lines 15-17; fig. 6)

Regarding claims 54-56, Ma discloses the step of CMP to planarize the substrate (col 6, lines 10-13)

6. Claims 57-76 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ma et al (US 6,692,546) in view of Jun et al (US 2001/0038448)

Ma discloses a method for using the slurry for polishing copper. The method comprises the step of:

receiving the substrate containing a layer of metal 14 and a dielectric layer 12 (col 4, lines 55-66), the substrate comprises the layer 14 /overburden covering the dielectric field (fig. 1)

partially planarizing the layer 14/overburden (fig. 2)

polishing/etching metal to remove metal/ portion of metal from the substrate by contacting the substrate with an etching solution comprising activating agent/complexing agent for ions of metal and hydrogen peroxide/oxidizer at a pH in a range of between about 1-5 (col 8, lines 55-60; col 9, lines 15-37), contacting the metal with the slurry/etching solution (col 6, lines 44-46)

Unlike the instant claimed inventions as per claims 57, 67, Ma fails to disclose contacting comprises spraying the slurry/etching solution onto the wafer

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Jun, in a method for detecting scratches on wafer, discloses that in CMP slurry is sprayed onto the wafer (col 1, paragraph 0004)

Since Ma discloses that the slurry/etching solution is dispensed directly onto the wafer (col 5, lines 58-59), one skilled in the art at the time the invention was made would have found it obvious to modify Ma step of dispensing slurry onto the wafer surface by spraying the slurry/etching solution as per Jun because it is conventional in the art of CMP to spray slurry/etching solution onto the wafer surface as taught by Jun

The limitations of claims 60, 68, 70 have been discussed above

Regarding claims 58, 73, Ma discloses that the solution containing a cleaning agent/surfactant (col 9, lines 18-20)

Regarding claims 59, 74, Ma discloses that the solution containing BTA/corrosion inhibitor (col 9, lines 40-42)

Regarding claims 61, 69, 76, Ma discloses that the solution containing 0 to 3% of glycine by weight and between about 0.1% to 25 % of hydrogen peroxide by weight (col 8, lines 55-60; col 9, lines 15-37)

Regarding claims 62, 75, Ma discloses that the solution has a pH of 6.9 (col 8, lines 40-41)

Regarding claims 63-64, 71-72, Ma discloses forming copper/capping layer over the entire wafer which includes the exposed metal (col 10, lines 15-17; fig. 6)

Regarding claims 65-66, Ma discloses the step of CMP to planarize the substrate (col 6, lines 10-13)

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7. Claims 10-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al (US 6,355,153) in view of Ma et al (US 6,692,546)

Uzoh method has been described above. Unlike the instant claimed inventions as per claims 10-13, Uzoh fails to disclose the step of removing the metal oxide using an etchant comprises glycine

Ma discloses a method for using the slurry for polishing copper. The method comprises the step of removing the metal oxide using an etchant comprises glycine (col 9, lines 5-37)

Hence, one skilled in the art at the time the invention was made would have found it obvious to modify Uzoh by adding the step of removing the metal oxide using an etchant comprises glycine as per Ma because according to Ma, glycine may be a cleaning agent that slowly etches or chelates to the copper, leading to soluble copper complexes that can be readily removed during polishing (col 9, lines 31-37)

8. Claims 25-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al (US 6,355,153) in view of Maekawa (US 6,329,284)

Uzoh method has been described above. Unlike the instant claimed inventions as per claims 25-27, Uzoh fails to disclose the step of contacting the substrate with an oxidizing gas that oxidizes the exposed metal at a temperature of 200-300⁰ C

Maekawa discloses a method of fabricating a semiconductor device comprises the steps of contacting the substrate with an oxidizing gas that oxidizes the exposed metal at a temperature of 300- 500⁰ C

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Hence, one skilled in the art at the time the invention was made would have found it obvious to modify Uzoh method by adding the step of contacting the substrate with an oxidizing gas that oxidizes the exposed metal at a temperature of 300- 500⁰ C as per Maekawa discloses that when the conductor is copper, an oxidizing atmosphere containing 2 to 30% of oxygen is employed (col 7, lines 5-10)

9. Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over Uzoh et al (US 6,355,153) in view of Shue et al (US 6,716,753)

Uzoh method has been described above. Unlike the instant claimed inventions as per claim 35, Uzoh fails to disclose the step of nitriding the capping layer

Shue discloses a method for forming a copper interconnect comprises the step of nitriding a capping layer (col 4, lines 7-9)

One skilled in the art at the time the invention was made would have found it obvious to modify Uzoh by adding the step of nitriding the capping layer to form a self-passivation layer as taught by Shue (col 4, lines 8-10)

Allowable Subject Matter

10. Claim 33 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments based on Uzoh and Ma

11. Applicant's arguments filed 12/5/2005 have been fully considered but they are not persuasive.

The applicants argue that there is no reason to assume from Uzoh's disclosure that any etching occurred within the cavities during the planarization step to expose the barrier layer 4 because although Figure 3BiiB does indeed show that some metal is not present at a position below an upper level of the exposed dielectric layer, the missing metal is not resulted from etching to the extent that there is a recess in metal below a dielectric region in Uzoh's process, that recess was present when the metal 24 was deposited as shown at Fig. 3Biia. This argument is unpersuasive because as clearly shown in fig. 3Biia-3BiiB, portion of metal layer 24 is planarized/removed/etched to a position below the upper level of exposed dielectric 4

The applicants also argue that, the slurry described in the cited sections of Ma et al. would etch metal from a substrate by CMP whereas the claim invention requires contacting the metal with an etching solution. This argument is not convincing because as disclosed in col 7, lines 1-6, Ma discloses that the slurry contains an activating agent that etch the oxidized copper. For the above reasons, the examiner maintained the rejection of claims 1-32, 34-76 based on Uzoh and Ma

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Conclusion

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 571 272 1471. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571 272 1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



LV
February 9, 2006